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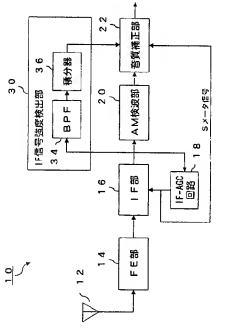
(71)出願人　000001889
三洋電機株式会社
大阪府守口市京阪本通２丁目５番５号
(74)代理人　100075258
弁理士　吉田　研二
(74)代理人　100096976
弁理士　石田　純
(72)発明者　菅藤　康二
大阪府守口市京阪本通２丁目５番５号　三洋電機株式会社内
(72)発明者　平社　豊
大阪府守口市京阪本通２丁目５番５号　三洋電機株式会社内

最終頁に続く

(54)【発明の名称】AM受信回路

(57)【要約】
【課題】受信放送波電界強度が弱い場合にも適切な音質補正を行うAM受信回路を提供する。
【解決手段】ＩＦ部１６は、所望の放送波の搬送周波数を、所定の中間周波数に変換し、増幅器によって増幅して出力する。ＩＦ－ＡＧＣ回路１８は、中間周波信号出力の一部を取り出し、ＩＦ部１６の増幅器の利得を制御する。ＩＦ信号部１６の出力信号は、ＡＭ検波部２０に入力され、搬送波成分を取り除き、もとの変調信号である音声信号を得る。AM検波部２０から出力された音声信号は音質補正部２２に入力され、音声信号の周波数特性を変化させて、音質を補正する。ＩＦ強度検出部３０は、ＩＦ部１６から出力されたＩＦ信号の搬送波周波数成分をＢＰＦ３４で抽出し、そのＩＦ信号搬送波の強度を積分器３６で直流電圧信号に変換する。音質補正部２２は、受信電界強度が弱い場合、ＩＦ信号搬送波強度信号に基づいて音質の補正を行う。
【選択図】図４



【特許請求の範囲】
【請求項１】
受信放送波から生成された中間周波数信号を増幅し、出力する中間周波数信号部と、
前記中間周波数信号出力からＡＭ変調信号を検波し、出力するＡＭ検波部と、
前記ＡＭ検波部の出力信号の音質を補正する音質補正部と、
を備えたＡＭ受信回路であって、
前記中間周波数信号出力から搬送波周波数成分を抽出するバンドパスフィルタと、
前記バンドパスフィルタからの出力を積分し、前記中間周波数信号の搬送波の強度を直流電圧に変換し、出力する積分器と、
を有し、
前記積分器から出力された直流電圧に応じて前記音質の補正を行うことを特徴とするＡＭ受信回路。
【請求項２】
アンテナから入力された受信放送波信号を増幅して出力するフロントエンド部と、
前記受信放送波信号出力から中間周波数信号を生成し、増幅して出力する中間周波数信号部と、
前記中間周波数信号出力からＡＭ変調信号を検波し、出力するＡＭ検波部と、
前記ＡＭ検波部の出力信号の音質を補正する音質補正部と、
前記中間周波数信号出力から搬送波成分を抽出するバンドパスフィルタと、
前記バンドパスフィルタからの出力を積分し、前記中間周波数信号の搬送波の強度を直流電圧に変換し、出力する積分器と、
を備えたＡＭ受信回路であって、
前記フロントエンド部、または、中間周波数信号部の少なくとも一方に、それぞれ前記受信放送波信号出力強度、または、中間周波数信号出力強度を制御するＡＧＣ回路が接続され、
前記音質補正部は、前記ＡＧＣ回路が出力するシグナルメータ信号の強度に応じて音質の補正を行い、前記シグナルメータ信号が所定の強度より小さいとき、前記積分器が出力する前記積分器から出力された直流電圧に応じて音質の補正を行うことを特徴とするＡＭ受信回路。
【発明の詳細な説明】
【技術分野】
【０００１】
本発明はＡＭ受信回路、特に受信放送波の電界強度が弱い場合に、その電界強度に応じた音質補正を行うＡＭ受信回路に関する。
【背景技術】
【０００２】
ＡＭ（振幅変調）方式は、伝送したい信号（変調信号）を、放送局から放射可能な周波数（搬送波）の振幅に乗せて伝送する方法であって、主に中波ラジオ放送（５２６．５～１６０６．５ｋＨｚ）に用いられている。中波放送用周波数帯の電波は、地表波による伝播のほか、特に夜間には地上１００ｋｍ付近の電離層（Ｅ層）で反射する空間波による伝播も加わり、広いサービスエリアを確保することができるとともに、車などの移動体に対しても安定したサービスができるという特徴がある。
【０００３】
ＡＭ信号を受信する受信装置において、一般にスーパーヘテロダイン検波方式が用いられている。スーパーヘテロダイン検波方式とは、放送局からの信号と受信装置に内蔵した発振（局部発振）回路による信号とを合成し、このビートを検波して中間周波に置き換え増幅し、復調する方式をいい、高い増幅利得を得やすい、混信を防ぎやすいという特徴を有している。さらに、ＡＭ信号を受信する受信回路には希望する放送波の周波数のみ通過させるバンドパスフィルターが必要とされるが、フィルターの帯域特性を変えずにその中心周波数を連続的に変化させることは非常に難しいため、局部発振周波数を変化させ、一

定の周波数に変換された中間周波数のみを通過させる方法が採用されている。

【０００４】

ＡＭ信号を受信する受信装置において、アンテナから入力される受信放送波電界強度に応じて、出力する音声信号である検波信号レベルが変動したり、混信が発生しやすくなったりする。

【０００５】

そこで、従来、受信ＲＦ信号を増幅するためのＡＧＣ（オートゲインコントロール）回路の感度を受信放送波電界強度により変更することによって、混信の発生を抑える方法が提案されている（例えば特許文献１参照）。

【０００６】

一般に、ＡＭ信号を受信する受信装置において、アンテナから入力される受信放送波の電界強度が変動した場合でも、出力する音声信号を一定に保つように、ＲＦ信号増幅器ないし中間周波数増幅器の増幅率を調整するためのＡＧＣ回路が設けられている。

【０００７】

しかし、アンテナから入力される受信放送波の電界強度が弱くなるにしたがって、ＡＭ受信機のスピーカー出力等には、音声信号に対して増幅器等から発生するノイズが増える。

【０００８】

そこで、弱電界入力時におけるＳＮ比（Ｓｉｇｎａｌ ｔｏ Ｎｏｉｓｅ ｒａｔｉｏ：信号対雑音比）の低下による聴感上の耳障りを抑制するために、検波部以降の音声信号回路において、その音質を補正するための音質補正回路が設けられている。

【０００９】

例えば、ＦＭ受信装置において、受信放送波電界強度に基づいて、トーンコントロール回路を制御し、出力信号の音質を調整する方法が提案されている（特許文献２参照）。

【００１０】

【特許文献１】特開平７－２２９７５号公報

【特許文献２】特開２０００－１３３４０号公報

【発明の開示】

【発明が解決しようとする課題】

【００１１】

ＡＭ信号を受信する受信装置において、受信放送波信号の電界強度情報として、ＡＧＣ回路のＡＧＣ制御電圧（以下Ｓメータ信号出力という）が、一般に利用されている。

【００１２】

ここで、従来のＡＭ受信回路における音質補正方法について説明する。図１は、従来のＡＭ受信回路の一実施形態であるＡＭ受信回路１００の構成の概略を示す図である。放送波は、アンテナ１１２で受け、ＦＥ（フロントエンド）部１１４に入力される。ＦＥ部１１４は、ＲＦ増幅器を備え、放送波信号を同期選択して増幅し出力する。ＩＦ（Ｉｎｔｅｒｍｅｄｉａｔｅ Ｆｒｅｑｕｅｎｃｙ：中間周波数）信号部１１６は、搬送波周波数の変換を行う機能を有し、受信放送波周波数から所定の周波数（通常４５０ｋＨｚ）異なる信号を出力する局部発信器と、前記放送波信号と局部発信信号とを混合する混合器とを備え、受信した放送波のうち所望の放送波の搬送波を、所定の中間周波数（通常４５０ｋＨｚ）に変換する。さらに、その中間周波数を中心周波数とするバンドパスフィルター（ＢＰＦ）によって所望の信号のみ抽出し、中間周波数信号（ＩＦ信号）として、増幅して出力する。ここで、ＡＭ受信回路１００には、１Ｆ信号部１１６のＩＦ出力信号強度を一定とするためにＩＦ－ＡＧＣ回路１１８を備えている。ＩＦ－ＡＧＣ回路１１８は、１Ｆ信号部１１６の出力の一部を受け取り、ＡＧＣ制御電圧（シグナルメータ信号）を発生させ、１Ｆ信号部１１６の入力にフィードバックさせることによりＩＦ信号部１１６の増幅器の利得を制御する。

【００１３】

次に、ＩＦ信号部１１６の出力信号は、ＡＭ検波部１２０に入力される。ＡＭ検波部１

２０は、ＩＦ信号から搬送波成分を取り除き、もとの変調信号である音声信号を得る。音質補正部１２２は、ＩＦ－ＡＧＣ回路１１８が発生させたシグナルメータ（Ｓメータ）信号を、受信放送電界強度情報を反映するものとして利用し、それに応じて音質補正を行っている。

【００１４】

図２はアンテナ１１２で受けた受信電界強度に対する、ＩＦ信号部１１６の増幅器への入力信号強度（実線）と該増幅器の増幅度（破線）との関係を示した図である。原則として受信電界強度が大きくなるにしたがって、増幅器への入力信号強度は大きくなり、増幅器の増幅度はＡＧＣ回路１１８の働きにより、小さくなる。しかしながら、受信電界強度Ｅ１以下においては、ＩＦ信号部１１６の増幅器の増幅度（回路の増幅率）は、有限であるため、増幅器の増幅度は、受信電界強度によらず一定の値となる。

【００１５】

一方、図３にアンテナ１１２で受けた受信電界強度に対する、ＩＦ信号部１１６の増幅器の増幅度（破線）とＳメータ信号出力（実線）との関係を示す。受信電界強度がＥ１以上では、増幅器の増幅度は、ＡＧＣ回路１１８により出力信号強度一定とすべく制御されているので、ＡＧＣ回路１１８は受信放送波信号の電界強度に応じたＳメータ信号を出力する。しかしながら、受信電界強度がＥ１以下では、検波出力であるＳメータ信号は、その検出感度が低いため、出力されず、ＡＧＣ回路１１８が機能せず、ＩＦ部増幅器の増幅度は一定となる。

【００１６】

したがって、従来のＳメータ信号出力を受信放送波の電界強度情報として利用する方法では、受信放送波信号の電界強度がＥ１より大きい場合では、その電界強度に応じた音質補正ができるが、受信放送波信号の電界強度がＥ１より小さいような弱電界強度環境下においては、電界強度情報を得ることができず、聴感上の耳障りを抑制するために、その音質を適正に補正することができなかった。

【００１７】

そこで本願発明は、弱電界強度環境において、その電界強度を検出し、その電界強度に応じた音質補正を行うＡＭ受信回路を提供する。

【課題を解決するための手段】

【００１８】

本発明のＡＭ受信回路は、受信放送波から生成された中間周波数信号を増幅し、出力する中間周波数信号部と、前記中間周波数信号出力からＡＭ変調信号を検波し、出力するＡＭ検波部と、前記ＡＭ検波部の出力信号の音質を補正する音質補正部と、を備えたＡＭ受信回路であって、前記中間周波数信号出力から搬送波周波数成分を抽出するバンドパスフィルタと、前記バンドパスフィルタからの出力を積分し、前記中間周波数信号の搬送波の強度を直流電圧に変換し、出力する積分器と、を有し、前記直流電圧に応じて前記音質の補正を行うことを特徴とする。

【００１９】

この構成によれば、受信放送波電界強度が弱い場合にも、受信放送波電界強度を検出することができ、耳障りを抑制する音質補正を適切に行うことができる。

【００２０】

また、本発明のＡＭ受信回路は、アンテナから入力された受信放送波信号を増幅して出力するフロントエンド部と、前記受信放送波信号出力から中間周波数信号を生成し、増幅して出力する中間周波数信号部と、前記中間周波数信号出力からＡＭ変調信号を検波し、出力するＡＭ検波部と、前記ＡＭ検波部の出力信号の音質を補正する音質補正部と、前記中間周波数信号出力から搬送波成分を抽出するバンドパスフィルタと、前記バンドパスフィルタからの出力を積分し、前記中間周波数信号の搬送波の強度を直流電圧に変換し、出力する積分器と、を備えたＡＭ受信回路であって、前記フロントエンド部、または、中間周波数信号部の少なくとも一方に、それぞれ前記受信放送波信号出力強度、または、中間周波数信号出力強度を制御するＡＧＣ回路が接続され、前記音質補正部は、前記ＡＧＣ回

路が出力するシグナルメータ信号の強度に応じて音質の補正を行い、前記シグナルメータ信号が所定の強度より小さいとき、前記積分器が出力する前記直流電圧に応じて音質の補正を行うことを特徴とする。

【００２１】

この構成によれば、シグナルメータ信号が所定の強度より小さい場合にも、受信放送波電界強度を検出することができ、耳障りを抑制する音質補正を適切に行うことができる。

【発明の効果】

【００２２】

以上のように本発明では、中間周波数信号出力から搬送波周波数成分をバンドパスフィルタにより抽出し、前記バンドパスフィルタからの出力を積分して、前記中間周波数信号の搬送波周波数成分の強度を直流電圧に変換する。そして、前記直流電圧に応じて前記音質の補正を行う。従って、受信放送波電界強度が弱い場合にも、受信電界強度を検出することができ、耳障りを抑制する音質補正を適切に行うことができる。

【発明を実施するための最良の形態】

【００２３】

以下、本発明の実施形態について、図面に基づいて説明する。

【００２４】

図４は、本発明の実施形態１に係るＡＭ受信回路１０の構成を示す図である。

【００２５】

放送波は、アンテナ１２で受け、ＦＥ（フロントエンド）部１４に入力される。ＦＥ部１４は、放送波（ＲＦ）信号を同期選択して出力する。ここで、ＦＥ部１４は、ＲＦ信号を増幅するためのＲＦ増幅器を備えてもよい。

【００２６】

ＩＦ（ｉｎｔｅｒｍｅｄｉａｔｅ　Ｆｒｅｑｕｅｎｃｙ：中間周波数）部１６は、搬送波周波数の変換を行う機能を有し、所望の放送波周波数より所定の周波数（通常４５０ｋＨｚ）異なる信号を出力する局部発信器と、前記放送波信号と局部発信信号とを混合する混合器とを備え、受信した放送波のうち所望の放送波の搬送波を、所定の中間周波数（通常４５０ｋＨｚ）に変換する。さらに、その中間周波数を、中心周波数とするバンドパスフィルター（ＢＰＦ）によって抽出し、放送波と同じ情報の振幅変調信号であるＩＦ信号とし、増幅器によって増幅して出力する。ここで、ＩＦ部１６は、４５０ＫＨｚを搬送波とするＩＦ信号を生成する１段構成としたが、一旦１０．７ＭＨｚにアップコンバートするファーストＩＦ段とそのファーストＩＦ信号を４５０ｋＨｚにダウンコンバートするセカンドＩＦ段との２段構成としてもよい。１０．７ＭＨｚのＩＦ信号はＦＭ受信回路において用いられる周波数であり、この構成によれば、ＡＭ放送波とＦＭ放送波とを受信する受信機において、ＩＦ部以降の回路を共有することができる。

【００２７】

ＩＦ部１６への入力信号強度は、アンテナ１２に入力される放送波信号強度、すなわち、放送波電界強度に比例し、受信場所や受信局によってその電界強度が変化した場合に、その出力信号レベルも変動し、出力される音声信号のレベルも変動してしまう。そこで、ＩＦ部１６の出力信号レベルを一定に保つためのＩＦ－ＡＧＣ（Ａｕｔｏｍａｔｉｃ　Ｇａｉｎ　Ｃｏｎｔｒｏｌ；自動利得制御）回路１８を備える。ＩＦ－ＡＧＣ回路１８は、中間周波信号出力の一部を取り出し、ダイオードで振幅に比例した直流電圧（ＡＧＣ電圧：シグナルメータ信号）を作り、そのシグナルメータ信号に基づいて、ＩＦ部１６の増幅器の利得を制御する。すなわち、ＩＦ－ＡＧＣ回路１８は入力される受信電界強度が弱いときにＩＦ部１６の増幅器の利得を上げ、受信電界強度が強いときにＩＦ部１６の増幅器の利得を下げ、入力される受信電界強度の変動が音声出力に現れないようにする。

【００２８】

シグナルメータ信号は、２段構成を成すＩＦ部においては、ファーストＩＦ段の出力から作っても良いし、セカンドＩＦ段の出力から作っても良い。また、ＩＦ信号をデジタル信号化して復調するＤＳＰ（デジタルシグナルプロセッサ）構成の受信回路においては、

デジタルＩＦ信号から演算により作っても良い。

【００２９】

ＩＦ信号部１６の出力信号は、ＡＭ検波部２０に入力される。ＡＭ検波部２０は、搬送波成分を取り除き、もとの変調信号である音声信号を得る。

【００３０】

ＡＭ検波部２０から出力された音声信号は音質補正部２２に入力される。音質補正部２２は、音声信号の周波数特性を変化させ、音質を補正する。このような音質補正は、受信放送波電界強度に応じて行われることが望ましい。例えば、受信放送波電界強度が十分大きい場合、音質補正は必要とはならないが、受信放送波電界強度が小さいとき、ＩＦ－ＡＧＣ回路１８によりＩＦ部１６の有する増幅回路の増幅率が大きくなるため、増幅回路から発生する広い帯域の及ぶノイズの割合が音声信号に対して大きくなる。このような場合、音声信号の中心周波数から外れた帯域を減衰させて、音声信号に対するノイズの割合を減少させ、聴感上の耳障りを抑制したり、全体に出力レベルを上げて、音声信号を聞き取りやすくしたり、さらにこれらを組み合わせたりする。これらの補正は、受信放送波電界強度に応じて切り替えることとしても良いし、受信放送波電界強度に比例させて補正の程度を変更しても良い。音質補正部２２はアナログ回路から構成しても良いし、デジタル信号で処理を行うＤＳＰ（デジタルシグナルプロセッサ）で構成しても良い。

【００３１】

音質補正部２２の出力は、増幅回路に送られ、増幅された後、スピーカー等から出力される。

【００３２】

本発明において特徴的なことは、受信放送波電界強度の検出を、ＩＦ信号の搬送波強度に基づいて行い、音質補正部２２は、受信放送波電界強度が弱い場合、そのＩＦ信号搬送波強度に応じて音質の補正を行うことである。ここで、ＩＦ信号搬送波強度は、ＩＦ部１６から出力されたＩＦ信号の搬送波周波数成分をＢＰＦ３４で抽出し、そのＩＦ信号の搬送波を積分器３６で直流電圧信号に変換した信号として得られる。したがって、この方法によれば、ＩＦ信号の搬送波周波数成分の強度を検出するため、受信電界強度が小さい場合でも、受信電界強度を反映した受信電界強度情報を得ることができる。ＢＰＦ３４は、搬送波周波数成分だけを鋭く選択するほど、他の周波数のノイズの影響を排除することができる。ＩＦ信号強度検出部３０では、ＩＦ搬送波周波数成分のみ通過させればよいため、音声信号用のＩＦ信号セラミックフィルタより狭帯域のＢＰＦを用いることが望ましい。また、ＩＦ信号をデジタル信号化した場合には、デジタル信号処理により狭帯域なＢＰＦ処理を行うことが好ましい。

【００３３】

図５に受信放送波電界強度に対する、ＩＦ信号搬送波強度信号およびシグナルメータ信号強度を示す。受信放送波電界強度がＥ１以下では、増幅器の増幅率の限界によりＡＧＣ回路が機能しないため、シグナルメータ信号は出力されないが、受信放送波電界強度に応じてＩＦ信号搬送波強度信号は出力される。

【００３４】

したがって、受信放送波電界強度がＥ１以下では、ＩＦ信号搬送波強度が受信放送電界強度を反映する情報となる。ここで、シグナルメータ信号が出力され始める電界強度（Ｅ１）は、受信回路のＦＥ部、ＩＦ部の回路構成等によっても異なるが２０μＶ程度である。

【００３５】

本実施形態によれば、シグナルメータ信号が出力されないような弱電界強度（約２０μＶ以下）においても、ＩＦ信号搬送波強度に基づいて、正確な放送波電界強度情報を得ることができ、その受信電界強度に応じて音質の補正を最適に行うことができる。

【００３６】

この放送波電界強度情報の検出構成は、ＦＭ受信回路に比較して、ＡＭ受信回路において特に有用である。ＦＭ受信回路においては、ＩＦ信号周波数である４５０ｋＨｚの搬送

波強度は電界強度によらず、ほぼ一定になるのに対し、ＡＭ受信回路においては、受信放送波電界強度が弱い場合、ＩＦ信号波は受信放送波電界強度を反映したものになるためである。

【００３７】

ここで、音質補正部２２は、図５における受信放送波電界強度がＥ１以上の場合、シグナルメータ信号に基づいて音質補正を行うことが好ましい。受信放送波電界強度がＥ１以上の場合、ＩＦ－ＡＧＣ回路１８によりＩＦ部１６から出力されるＩＦ信号の搬送波強度は一定となり、ＩＦ信号の搬送波周波数成分の強度は、受信放送波電界強度の情報とはならない。この場合、シグナルメータ信号が受信放送波電界強度を反映する情報となり、音質補正部２２は、シグナルメータ信号に基づいて音質補正を行うことにより、受信放送波電界強度に応じ、適切な音質補正を行うことができる。

【００３８】

音質補正部２２において、その音質補正を、受信放送波電界強度が弱い場合にＩＦ信号搬送波強度に基づいて行い、受信放送波電界強度が強い場合にシグナルメータ信号に基づいて行うことは、両者の信号を加算することにより、実現することができる。これは、図５に示すように、受信放送波電界強度が弱い場合（Ｅ１以下）では、シグナルメータ信号は出力されず、受信放送波電界強度が強い場合（Ｅ１以上）では、ＩＦ信号搬送波強度が一定となるため、両者の加算信号は、受信放送波電界強度が弱い場合（Ｅ１以下）でも、強い場合（Ｅ１以上）でも、受信放送波電界強度を反映したものとなるためである。また、加算せず、両者をＩＦ信号搬送波強度が所定の強度となる場合、もしくはシグナルメータ信号強度が所定の強度となる場合に切り替えることとしてもよい。

【００３９】

さらに、実施形態１に係るＡＭ受信回路１０において、ＲＦ－ＡＧＣ回路を備え、ＦＥ部１４の出力信号強度に応じてＦＥ部１４に備えられたＲＦアンプの増幅率を制御してもよい。この場合、ＲＦ－ＡＧＣ回路は、ＲＦ－ＡＧＣ制御電圧（ＲＦ－シグナルメータ信号）を出力し、これを前記説明した、ＩＦ－ＡＧＣ回路１８が出力するシグナルメータ信号に代えてもよし、両者を選択、加算、組み合わせ等した信号をシグナルメータ信号とすることもできる。

【図面の簡単な説明】

【００４０】

【図１】従来のＡＭ受信回路の一実施形態であるＡＭ受信回路１００の構成の概略を示す図である。

【図２】受信電界強度に対する、ＩＦ信号部の増幅器への入力信号強度（実線）と増幅器の増幅度（破線）との関係を示した図である。

【図３】受信電界強度に対する、増幅器の増幅度（破線）とＳメータ信号出力（実線）との関係を示す図である。

【図４】本発明の実施形態１に係るＡＭ受信回路１０の構成を示す図である。

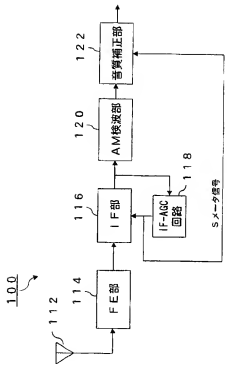
【図５】受信放送波電界強度に対する、ＩＦ信号搬送波強度およびシグナルメータ信号強度を示す図である。

【符号の説明】

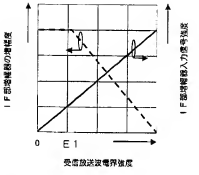
【００４１】

１０，１００　ＡＭ受信回路、１２，１１２　アンテナ、１４，１１４　ＦＥ（フロントエンド）部、１６，１１６　ＩＦ信号部、１８，１１８　ＩＦ－ＡＧＣ回路、２０，１２０　検波部、２２，１２２　音質補正部、３４　ＢＰＦ、３６　積分器。

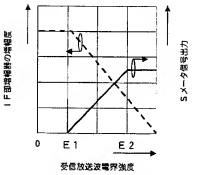
【図１】


100
112
114
FE部
116
IF部
IF-AGC回路
118
Sメータ信号
120
AM検波部
122
音質補正部

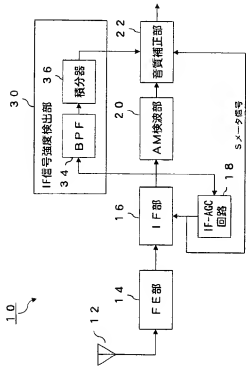
【図２】


IF部増幅器の増幅度
IF部増幅器入力信号強度
0
E1
受信放送波電界強度

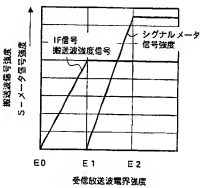
【図３】


IF部増幅器の増幅度
Sメータ信号出力
0
E1
E2
受信放送波電界強度

【図４】


10
12
14
FE部
16
IF部
IF-AGC回路
18
Sメータ信号
20
AM検波部
22
音質補正部
30
IF信号強度検出部
34
BPF
36
積分部

【図５】


放送波電界強度
S－メータ信号強度
IF信号
搬送波強度信号
シグナルメータ
信号強度
E0
E1
E2
受信放送波電界強度

フロントページの続き

(72)発明者 平 正明
大阪府守口市京阪本通２丁目５番５号 三洋電機株式会社内

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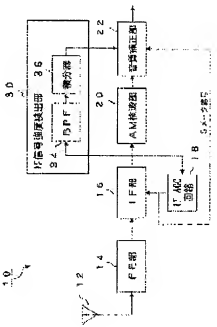
(71)Applicant : SANYO ELECTRIC CO LTD
(72)Inventor : SAITO KOJI
HIRAKOSO YUTAKA
TAIRA MASAAKI

(54) AM RECEIVING CIRCUIT

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an AM receiving circuit for performing appropriate sound quality correction even if a received broadcast wave electric field strength is weak.
SOLUTION: An IF section 16 converts a carrier frequency of a desired broadcast wave into a predetermined intermediate frequency, and the converted wave is amplified by an amplifier and outputted. An IF-AGC circuit 18 takes out a part of the intermediate frequency signal output, and controls the gain of the amplifier of the IF section 16. The output signal of the IF signal section 16 is inputted into an AM detection circuit 20, and the carrier wave component is removed to obtain an original modulation audio signal. The audio signal outputted from the AM detection section 20 is inputted into a sound quality corrector 22, and the frequency characteristic of the audio signal is varied to correct the sound quality. In an IF strength detector 30, a BPF 34 extracts the carrier wave frequency component of the IF signal outputted from the IF section 16, and an integrator 36 converts the strength of the IF signal carrier wave into a DC voltage signal. When the received electric field strength is weak, the corrector 22 corrects sound quality on the basis of the IF signal carrier wave strength signal.



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CLAIMS

[Claim(s)]
[Claim 1]
The intermediate frequency signal section which amplifies and outputs the intermediate frequency signal generated from the received broadcast wave,
AM detection section which detects and outputs an AM signal from said intermediate frequency signal output,
The tone-quality amendment section which amends the tone quality of the output signal of said AM detection section,
It is a ******** AM receiving circuit,
The band pass filter which extracts a carrier frequency component from said intermediate frequency signal output,
The integrator which integrates with the output from said band pass filter, and changes and outputs the reinforcement of the subcarrier of said intermediate frequency signal to direct current voltage,
It ****,
AM receiving circuit characterized by amending said tone quality according to the direct current voltage outputted from said integrator.
[Claim 2]
The front end section which amplifies and outputs the received broadcast wave signal inputted from the antenna,
The intermediate frequency signal section which generates, amplifies and outputs an intermediate frequency signal from said received broadcast wave signal output,
AM detection section which detects and outputs an AM signal from said intermediate frequency signal output,
The tone-quality amendment section which amends the tone quality of the output signal of said AM detection section,
The band pass filter which extracts a carrier component from said intermediate frequency signal output,
The integrator which integrates with the output from said band pass filter, and changes and outputs the reinforcement of the subcarrier of said intermediate frequency signal to direct current voltage,
It is a ******** AM receiving circuit,
The AGC circuit which controls said received broadcast wave signal output reinforcement or intermediate frequency signal output reinforcement, respectively is connected to either [at least] said front end section or the intermediate frequency signal section,
Said tone-quality amendment section is an AM receiving circuit characterized by amending tone quality according to the reinforcement of the signal meter signal which said AGC circuit outputs, and amending tone quality according to the direct current voltage outputted from said integrator which said integrator outputs when said signal meter signal is smaller than predetermined reinforcement.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[Field of the Invention]
[0001]
This invention relates to AM receiving circuit which performs tone-quality amendment according to the field strength, when the field strength of AM receiving circuit, especially a received broadcast wave is weak.
[Background of the Invention]
[0002]
AM (amplitude modulation) method is the approach of putting and transmitting a signal (modulating signal) transmitting to the amplitude of the frequency (subcarrier) which can be emitted from a broadcasting station, and is mainly used for the medium wave radio broadcasting (526.5 to 1606.5 kHz). The electric wave of a medium wave broadcast band has the description that service stabilized also to mobiles, such as a vehicle, can be performed while the propagation by the space wave reflected [especially] by the ionized layer near 100km above ground (E layer) at night besides the propagation by the ground wave can also be added and it can secure a large service area.
[0003]
Generally in the receiving set which receives an AM signal, the superheterodyne detection method is used. A superheterodyne detection method compounds the signal from a broadcasting station, and the signal by the oscillation (local oscillation) circuit built in the receiving set, and means the method to which detects this beat, transposes to an intermediate frequency, and amplifies, and it restores, and it has the description which is easy to acquire high magnification gain of being easy to prevent interference. Furthermore, although the band pass filter which passes only the frequency of the broadcast wave to wish is needed for the receiving circuit which receives an AM signal, since it is very difficult to change the center frequency continuously, without changing the band property of a filter, a local oscillation frequency is changed and the method of passing only the intermediate frequency changed into the fixed frequency is adopted.
[0004]
In the receiving set which receives an AM signal, according to the received broadcast wave field strength inputted from an antenna, the detection signal level which is the sound signal to output is changed, or it becomes easy to generate interference.
[0005]
Then, the method of suppressing generating of interference is proposed by changing the sensibility of the AGC (automatic gain control) circuit for amplifying a receiving RF signal conventionally with received broadcast wave field strength (for example, patent reference 1 reference).
[0006]
Generally, even when the field strength of the received broadcast wave inputted from an antenna in the receiving set which receives an AM signal is changed, the AGC circuit for adjusting the amplification factor of RF-signal amplifier thru/or an intermediate frequency amplifier is prepared so that the sound signal to output may be kept constant.
[0007]
However, for the loudspeaker output of AM receiver, the noise generated from amplifier etc. to a sound signal increases as the field strength of the received broadcast wave inputted from an antenna becomes weak.
[0008]
Then, in order to control the lug harm on the audibility by the fall of the SN ratio at the time of a weak-electric-current community input (Signal to Noise ratio: signal-to-noise ratio), in the sound signal circuit after the detection section, the tone-quality amendment circuit for amending the tone quality is prepared.
[0009]

For example, in FM receiving set, based on received broadcast wave field strength, a tone control circuit is controlled and the method of adjusting the tone quality of an output signal is proposed (patent reference 2 reference).

[0010]

[Patent reference 1] JP,7-22975,A

[Patent reference 2] JP,2000-13340,A

[Description of the Invention]

[Problem(s) to be Solved by the Invention]

[0011]

Generally in the receiving set which receives an AM signal, the AGC control voltage (henceforth an S meter signal output) of an AGC circuit is used as field strength information on a received broadcast wave signal.

[0012]

Here, the tone-quality amendment approach in the conventional AM receiving circuit is explained. Drawing 1 is drawing showing the outline of the configuration of the AM receiving circuit 100 which is 1 operation gestalt of the conventional AM receiving circuit. An antenna 112 receives a broadcast wave and it is inputted into the FE (front end) section 114. The FE section 114 is equipped with RF amplifier, it makes synchronous selection, amplifies a broadcast wave signal, and outputs it. the function in which IF (Intermediate Frequency: intermediate frequency) signal section 116 changes carrier frequency --- having -- a frequency (usually 450kHz) predetermined from a received broadcast wave frequency -- it has the mixer which mixes the local transmitter which outputs a different signal, and said broadcast wave signal and a local dispatch signal, and the subcarrier of a desired broadcast wave is changed into a predetermined intermediate frequency (usually 450kHz) among the broadcast waves which received. Furthermore, with the band pass filter (BPF) which makes the intermediate frequency center frequency, only a desired signal is extracted, and it amplifies and outputs as an intermediate frequency signal (IF signal). Here, the AM receiving circuit 100 is equipped with IF-AGC circuit 118 in order to set constant IF output signal reinforcement of the IF signal section 116. IF-AGC circuit 118 controls the gain of the amplifier of the IF signal section 116 by generating reception and AGC control voltage (signal meter signal), and making a part of output of the IF signal section 116 feed back to the input of the IF signal section 116.

[0013]

Next, the output signal of the IF signal section 116 is inputted into AM detection section 120. AM detection section 120 removes a carrier component, and acquires the sound signal which is a modulating signal of a basis from an IF signal. The tone-quality amendment section 122 uses the signal meter (S meter) signal which IF-AGC circuit 118 generated as a thing reflecting reception broadcast field strength information, and is performing tone-quality amendment according to it.

[0014]

Drawing 2 is drawing to the received field strength received with the antenna 112 having shown the relation between the input signal reinforcement (continuous line) to the amplifier of the IF signal section 116, and the amplification degree (broken line) of this amplifier. The input signal reinforcement to amplifier becomes large, and the amplification degree of amplifier becomes small by work of AGC circuit 118 as received field strength becomes large in principle. However, in less than [received field strength E1], since the amplification degree (amplification factor of a circuit) of the amplifier of the IF signal section 116 is limited, the amplification degree of amplifier is not based on received field strength, but serves as a fixed value.

[0015]

On the other hand, the relation between the amplification degree (broken line) of the amplifier of the IF signal section 116 to the received field strength received in drawing 3 with the antenna 112 and an S meter signal output (continuous line) is shown. Since it is controlled that received field strength should consider amplification degree of amplifier as output signal regularity on the strength by AGC circuit 118 more than by E1, AGC circuit 118 outputs the S meter signal according to the field strength of a received broadcast wave signal. However, since the detection sensitivity of the S meter signal whose received field strength is a detection output in less than [E1] is low, it is not outputted, and AGC circuit 118 does not function, but the amplification degree of the IF section amplifier becomes fixed.

[0016]

Therefore, although tone-quality amendment according to the field strength can be performed in the case where the field strength of a received broadcast wave signal is larger than E1, by the approach of using the conventional S meter signal output as field strength information on a received broadcast wave In order to be unable to acquire field strength information under a weak-electric-current community environment on the strength which is smaller than E1 but to control the lug harm on audibility, the tone quality was not able to be amended proper.

[0017]
Then, in a weak-electric-current community environment on the strength, the invention in this application detects the field strength, and offers AM receiving circuit which performs tone-quality amendment according to the field strength.
[Means for Solving the Problem]
[0018]
The intermediate frequency signal section which AM receiving circuit of this invention amplifies the intermediate frequency signal generated from the received broadcast wave, and is outputted, AM detection section which detects and outputs an AM signal from said intermediate frequency signal output, The band pass filter which is AM receiving circuit equipped with the tone-quality amendment section which amends the tone quality of the output signal of said AM detection section, and extracts a carrier frequency component from said intermediate frequency signal output, It integrates with the output from said band pass filter, has the integrator which changes and outputs the reinforcement of the subcarrier of said intermediate frequency signal to direct current voltage, and is characterized by amending said tone quality according to said direct current voltage.
[0019]
According to this configuration, also when received broadcast wave field strength is weak, received broadcast wave field strength can be detected and tone-quality amendment which controls lug harm can be performed appropriately.
[0020]
Moreover, the front end section which AM receiving circuit of this invention amplifies the received broadcast wave signal inputted from the antenna, and is outputted, The intermediate frequency signal section which generates, amplifies and outputs an intermediate frequency signal from said received broadcast wave signal output, AM detection section which detects and outputs an AM signal from said intermediate frequency signal output, The tone-quality amendment section which amends the tone quality of the output signal of said AM detection section, and the band pass filter which extracts a carrier component from said intermediate frequency signal output, The integrator which integrates with the output from said band pass filter, and changes and outputs the reinforcement of the subcarrier of said intermediate frequency signal to direct current voltage, It is a ******** AM receiving circuit. Said front end section, At least to one side of the intermediate frequency signal section, respectively Or said received broadcast wave signal output reinforcement, The AGC circuit which controls intermediate frequency signal output reinforcement is connected. Or said tone-quality amendment section It is characterized by amending tone quality according to the reinforcement of the signal meter signal which said AGC circuit outputs, and amending tone quality according to said direct current voltage which said integrator outputs, when said signal meter signal is smaller than predetermined reinforcement.
[0021]
According to this configuration, also when a signal meter signal is smaller than predetermined reinforcement, received broadcast wave field strength can be detected and tone-quality amendment which controls lug harm can be performed appropriately.
[Effect of the Invention]
[0022]
As mentioned above, a band pass filter extracts a carrier frequency component from an intermediate frequency signal output, this invention is integrated with the output from said band pass filter, and the reinforcement of the carrier frequency component of said intermediate frequency signal is changed into direct current voltage by it. And said tone quality is amended according to said direct current voltage. Therefore, also when received broadcast wave field strength is weak, received field strength can be detected and tone-quality amendment which controls lug harm can be performed appropriately.
[Best Mode of Carrying Out the Invention]
[0023]
Hereafter, the operation gestalt of this invention is explained based on a drawing.
[0024]
Drawing 4 is drawing showing the configuration of the AM receiving circuit 10 concerning the operation gestalt 1 of this invention.
[0025]
An antenna 12 receives a broadcast wave and it is inputted into the FE (front end) section 14. The FE section 14 makes synchronous selection and outputs a broadcast wave (RF) signal. Here, the FE section 14 may be equipped with RF amplifier for amplifying a RF signal.
[0026]
the function in which the IF (Intermediate Frequency: intermediate frequency) section 16 changes carrier

frequency — having — a frequency (usually 450kHz) more nearly predetermined than a desired broadcast wave frequency — it has the mixer which mixes the local transmitter which outputs a different signal, and said broadcast wave signal and a local dispatch signal, and the subcarrier of a desired broadcast wave is changed into a predetermined intermediate frequency (usually 450kHz) among the broadcast waves which received. Furthermore, the band pass filter (BPF) made into center frequency extracts the intermediate frequency, it is made into the IF signal which is an amplitude-modulated signal of the same information as a broadcast wave, and is amplified and outputted with amplifier. Here, although the IF section 16 considered as the one-step configuration which generates the IF signal which makes 450kHz a subcarrier, it is once good for 10.7MHz also as a two-step configuration with the second IF stage which carries out the down convert of the first IF stage which carries out a rise convert, and its first IF signal at 450kHz. A 10.7MHz IF signal is a frequency used in FM receiving circuit, and according to this configuration, it can share the circuit after the IF section in the receiver which receives AM broadcast wave and FM broadcast wave.

[0027]

When the input signal reinforcement to the IF section 16 is proportional to the broadcast wave signal strength inputted into an antenna 12, i.e., broadcast wave field strength, and the field strength changes with a receiving location or receiving stations, the output-signal level and the level of the sound signal changed and outputted will be changed. Then, it has the IF-AGC (Automatic Gain Control; automatic gain control) circuit 18 for keeping constant the output-signal level of the IF section 16. IF-AGC circuit 18 takes out a part of intermediate frequency signal output, makes the direct current voltage (AGC electrical potential difference: signal meter signal) which is proportional to the amplitude for diode, and controls the gain of the amplifier of the IF section 16 based on the signal meter signal. That is, IF-AGC circuit 18 raises the gain of the amplifier of the IF section 16, when the received field strength inputted is weak, when received field strength is strong, it lowers the gain of the amplifier of the IF section 16, and it is made for fluctuation of the received field strength inputted not to appear in a voice output.

[0028]

In the IF section which accomplishes a two-step configuration, a signal meter signal may be made from the output of a first IF stage, and may be made from the output of a second IF stage. Moreover, in the receiving circuit of the DSP (digital signal processor) configuration to which digital-signal-izes an IF signal and it restores, you may make from a digital IF signal by the operation.

[0029]

The output signal of the IF signal section 16 is inputted into AM detection section 20. AM detection section 20 removes a carrier component, and acquires the sound signal which is a modulating signal of a basis.

[0030]

The sound signal outputted from AM detection section 20 is inputted into the tone-quality amendment section 22. The tone-quality amendment section 22 changes the frequency characteristics of a sound signal, and amends tone quality. As for such tone-quality amendment, it is desirable to be carried out according to received broadcast wave field strength. For example, since the amplification factor of the amplifying circuit which the IF section 16 has by IF-AGC circuit 18 becomes large when received broadcast wave field strength is small although tone-quality amendment is not necessary when received broadcast wave field strength is sufficiently large, the rate of a noise that the wide band generated from an amplifying circuit reaches becomes large to a sound signal. In such a case, the band from which it separated from the center frequency of a sound signal is attenuated, the rate of the noise to a sound signal is decreased, and an output level is raised to the whole, and that it is easy to catch a sound signal, and these are combined [it carries out or] further. [controlling the lug harm on audibility] These amendments are good also as changing according to received broadcast wave field strength, are proportioned in received broadcast wave field strength, and may change extent of amendment. The tone-quality amendment section 22 may be constituted from an analog circuit, and may consist of DSPs (digital signal processor) which process with a digital signal.

[0031]

The output of the tone-quality amendment section 22 is sent to an amplifying circuit, and after being amplified, it is outputted from a loudspeaker etc.

[0032]

That it is characteristic in this invention performs detection of received broadcast wave field strength based on the subcarrier reinforcement of an IF signal, and the tone-quality amendment section 22 is amending tone quality according to the IF signal carrier reinforcement, when received broadcast wave field strength is weak. Here, IF signal carrier reinforcement is obtained as a signal which extracted the carrier frequency component of the IF signal outputted from the IF section 16 by BPF34, and changed the subcarrier of the IF signal into the direct-current-voltage signal with the integrator 36. Therefore, according to this approach, since the

reinforcement of the carrier frequency component of an IF signal is detected, even when received field strength is small, the received field strength information reflecting received field strength can be acquired. BPF34 can eliminate the effect of the noise of other frequencies, so that it chooses only a carrier frequency component keenly. In order for what is necessary to be just to pass only IF carrier frequency component in IF signal strength detecting element 30, it is more desirable than the IF signal ceramic filter for sound signals to use BPF of a narrow-band. Moreover, when an IF signal is digital-signal-ized, it is desirable to perform narrow-band BPF processing by digital signal processing.

[0033]

IF signal carrier signal on the strength and signal meter signal strength to received broadcast wave field strength are shown in drawing 5 . Less than [E1], as for IF signal carrier signal on the strength, received broadcast wave field strength is outputted according to received broadcast wave field strength, although a signal meter signal is not outputted since an AGC circuit does not function according to the limitation of the amplification factor of amplifier.

[0034]

Therefore, less than [E1], received broadcast wave field strength serves as information in which IF signal carrier reinforcement reflects reception broadcast field strength. Here, although the field strength (E1) to which a signal meter signal begins to be outputted changes with circuitry of the FE section of a receiving circuit, and the IF section etc., it is about 20 microvolts.

[0035]

Also in weak-electric-current community reinforcement (about 20 microvolts or less) to which a signal meter signal is not outputted, based on IF signal carrier reinforcement, exact broadcast wave field strength information can be acquired, and, according to this operation gestalt, tone quality can be amended the optimal according to the received field strength.

[0036]

The detection configuration of this broadcast wave field strength information is useful especially in AM receiving circuit as compared with FM receiving circuit. in FM receiving circuit, when received broadcast wave field strength is weak, IF signal wave is [in / to the subcarrier reinforcement of 450kHz which is IF signal frequency not being based on field strength, but becoming about 1 law / AM receiving circuit] because it becomes a thing reflecting received broadcast wave field strength.

[0037]

Here, when the received broadcast wave field strength in drawing 5 is more than E1, as for the tone-quality amendment section 22, it is desirable to perform tone-quality amendment based on a signal meter signal. When received broadcast wave field strength is more than E1, the subcarrier reinforcement of the IF signal outputted by IF-AGC circuit 18 from the IF section 16 becomes fixed, and the reinforcement of the carrier frequency component of an IF signal does not serve as information on received broadcast wave field strength. In this case, a signal meter signal serves as information reflecting received broadcast wave field strength, and the tone-quality amendment section 22 can perform suitable tone-quality amendment by performing tone-quality amendment based on a signal meter signal according to received broadcast wave field strength.

[0038]

In the tone-quality amendment section 22, it is realizable by adding both signal to carry out based on IF signal carrier reinforcement, when received broadcast wave field strength is weak, and to perform the tone-quality amendment based on a signal meter signal, when received broadcast wave field strength is strong. Since a signal meter signal is not outputted but becomes fixed [IF signal carrier reinforcement] by the case (more than E1) where received broadcast wave field strength is strong, by the case (less than [E1]) where received broadcast wave field strength is weak as this shows drawing 5 , both addition signal is because it becomes a thing reflecting received broadcast wave field strength, even when received broadcast wave field strength is weak (less than [E1]), and even when strong (more than E1). Moreover, it is good also as changing, when it does not add but IF signal carrier reinforcement turns into predetermined reinforcement in both, or when signal meter signal strength turns into predetermined reinforcement.

[0039]

Furthermore, in the AM receiving circuit 10 concerning the operation gestalt 1, the amplification factor of the RF amplifier with which was equipped with RF-AGC circuit and the FE section 14 was equipped according to the output signal reinforcement of the FE section 14 may be controlled. In this case, even if it replaces RF-AGC circuit with the signal meter signal with which RF-AGC control voltage (RF-signal meter signal) is outputted, and said explained IF-AGC circuit 18 outputs this, it can be stopped, and it can also make the signal with which selection, addition, combination, etc. acted as both a signal meter signal.

[Brief Description of the Drawings]

[0040]
[Drawing 1] It is drawing showing the outline of the configuration of the AM receiving circuit 100 which is 1 operation gestalt of the conventional AM receiving circuit.
[Drawing 2] It is drawing to received field strength having shown the relation between the input signal reinforcement (continuous line) to the amplifier of the IF signal section, and the amplification degree (broken line) of amplifier.
[Drawing 3] It is drawing to received field strength showing the relation between the amplification degree (broken line) of amplifier, and an S meter signal output (continuous line).
[Drawing 4] It is drawing showing the configuration of the AM receiving circuit 10 concerning the operation gestalt 1 of this invention.
[Drawing 5] It is drawing showing IF signal carrier reinforcement and signal meter signal strength to received broadcast wave field strength.
[Description of Notations]
[0041]
10,100 AM receiving circuit, 12,112 An antenna, 14,114 The FE (front end) section, 16,116 The IF signal section, 18,118 IF-AGC circuit, 20,120 The detection section, 22,122 The tone-quality amendment section, 34 BPF, 36 Integrator.

[Translation done.]

* NOTICES *

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damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

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[Drawing 5] It is drawing showing IF signal carrier reinforcement and signal meter signal strength to received broadcast wave field strength.

[Translation done.]